

AD 633567

ORDNANCE DIVISION
CHAMBERLAIN CORPORATION
WATERLOO, IOWA

SIXTH
MONTHLY LETTER REPORT
DECEMBER 1965

PRODUCTION ENGINEERING OF PROJECTILE, HE, 107-MM, XM502

CONTRACT DA-28-017-AMC-2308(A)
AMCMS CODE NO. 4230.1.69880.1

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CHAMBERLAIN *Corporation*

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WATERLOO, IOWA 50705

19 January 1966
Approved 16 May 1966

Commanding Officer
Picatinny Arsenal
Dover, New Jersey 07801

Attention: Procurement and Production Directorate, SMUPA-PBI

Subject: Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)
AMCMS Code No. 4230.1.69880.1

Dear Sir:

The contents of this report are as follows:

1. GENERAL
 2. SELECTION OF MATERIALS
 3. TEST CYLINDERS
 4. PROJECTILES
 5. HOURS
 6. PLANNING
- APPENDIX I - ILLUSTRATIONS
APPENDIX II - FRAGMENTATION DATA
APPENDIX III - DISTRIBUTION LIST

I. GENERAL

I.1 Contractual

I.1.1 On 6 December 1965 the Corporation submitted a quotation to Picatinny Arsenal detailing the costs involved in redirecting efforts to production engineer the XM570 rather than the XM502 Projectile. Details of the changes to the scope of work were outlined in the November 1965 report. The quotation was being reviewed by the Arsenal at the time this report was written.

Copy 24 of 32

CHAMBERLAIN CORPORATION - WATERLOO, IOWA

Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)

1.1.2 On 8 December 1965 the Company received Modification 2, dated 3 December 1965, to the subject contract. This change designates the offices and individuals responsible for administration of the contract and also specifies the addresses for administrative contractual correspondence.

1.2 Reference Material

1.2.1 On 24 November 1965 the Company had written to Aberdeen Proving Ground (APG), Maryland, requesting a copy of Development and Proof Services Report DPS-TW-110-6. The scope of the contract states that end item effectiveness of the XM502 (or XM570) must be equivalent or superior to that cited in the report. Chamberlain Corporation previously had contacted Defense Documentation Center (DDC) and requested a copy, but DDC advised it was not available from that facility and recommended that it be requested from APG. In reply to the November letter of Chamberlain Corporation, APG stated that the report, AD 225 772, was available from DDC. The Company again will contact DDC for the document.

2. SELECTION OF MATERIALS

2.1 Certification was received from the supplier for the 1.1-1.2% carbon W1 tool steel received during November 1965. The data from the check analysis performed by the mill are tabulated below.

ELEMENT	C	Mn	P	S	Si
PERCENT	1.27	.30	.007	.006	.25

2.1.1 It should be noted that the 1.27% carbon content is above the range of 1.1 to 1.2% carbon specified on the purchase order. This deviation was relayed to the Technical Supervisor in a telephone conversation of 14 December 1965, and permission was given to use the 1.27% carbon steel.

2.2 The steel mill manufacturing the high carbon, high phosphorus steel notified Chamberlain Corporation that ultrasonic inspection of the bar had revealed an "indication," or evidence of possible flaw in the center of the bar. The mill advised that approximately 10 feet

CHAMBERLAIN CORPORATION - WATERLOO, IOWA

Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)

of 4.0 inches diameter bar would be shipped to the Company for testing to determine if it can be used. If metallurgical tests showed the bar to be sound, the mill would ship the remaining 30 feet. The information given by the mill was relayed to the Technical Supervisor in a telephone conversation on 14 December 1965.

2.2.1 On 20 December 1965 Chamberlain Corporation received approximately 10 feet of 4.0 inches diameter high carbon, high phosphorus steel bar per the arrangement discussed in 2.2, preceding. Samples were taken from the center and both ends of the bar for microetching and study. Photomicrographs of a sample taken from the center of the bar are shown on Photo No. 7284, Appendix I.¹ The results are representative of all samples studied. The structure of the bar appears to be spheroidized; however, other observations from study of the specimens were indicative of an unsound condition in the center of the bar for the entire length. Referencing the photograph, the black spots, some of which are connected or partially connected by black lines, appear to be evidence of a breakdown of the grain boundaries. The light area on the etch appears to be phosphorus segregation. Both of these conditions may have been caused during rolling of the bar from the billet (i.e., overworking). It was decided to process the bar into test cylinders and conduct similar laboratory tests on extruded pieces to determine if the unsound condition of the bar adversely affected grain flow. These tests, which will be conducted during January, will be the basis for a decision on ordering the remaining 30 feet of the heat.

2.3 Also during December 1965 a steel company offered Chamberlain Corporation, free of charge, approximately 40 feet of 4.0 inches diameter AISI 06 steel bar. This steel is from four experimental heats, each with varying carbon content. There is approximately 10 feet of each heat. Chamberlain Corporation accepted the material as being of possible interest to the program, and will fabricate test cylinders from it for fragmentation study. Results of mill check analyses of chemical composition of the steels are shown on Table 1. Transverse hardness readings of the steels are shown on Table 2.

¹ All illustrations cited in this report are included in Appendix I in order of reference unless otherwise specified.

CHAMBERLAIN CORPORATION - WATERLOO, IOWA

Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)

TABLE 1**CHEMICAL COMPOSITIONS OF FOUR EXPERIMENTAL STEELS
(Check Analyses)**

STEEL HEAT NO.	C	Mn	P	S	Si	Cr	Mo	* Al	N
V8232-1	1.49	0.41	0.022	0.029	1.00	0.03	0.26	0.007	0.008
V8233-1	1.45	0.99	0.022	0.026	1.11	0.03	0.30	0.013	0.007
V8234-1	1.47	1.46	0.026	0.026	0.96	0.03	<0.01	0.009	0.010
V8235-1	1.25	0.38	0.022	0.025	1.07	0.03	0.25	0.010	0.008
* Total									

TABLE 2**TRANSVERSE HARDNESS OF SLOW-COOLED BARS
OF FOUR EXPERIMENTAL STEELS**

STEEL HEAT NO.	ROCKWELL "C" HARDNESS		
	NEAR SURFACE	MIDRADIUS	CENTER
V8232-1	26.0	20.5	5.0
V8233-1	30.0	22.0	18.0
V8234-1	27.0	20.0	14.0
V8235-1	25.0	10.0	10.0

CHAMBERLAIN CORPORATION - WATERLOO, IOWA

Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)

3. TEST CYLINDERS

3.1 Fabrication

3.1.1 Manufacture of cylinders from all steels except W1 and the high carbon, high phosphorus steels has been completed. In addition, 50 slugs have been sawed from the W1 steel and 30 slugs have been sawed from the high carbon, high phosphorus steel. The former will be fabricated into cylinders during January. Processing of the latter will be done at the same time the W1 is processed. Metallurgical samples will be taken for macro, micro and hardness tests to determine the effect of the bar condition on grain flow and structure (Reference 2.2.1, preceding).

3.1.2 In addition to the six materials above, nine cylinders have been made from the 1.12% carbon, 25% molybdenum steel furnished free of charge to the Company (See 3.1.3 of the November 1965 Letter Report). Ten (10) each slugs also have been sawed from the experimental heat bars of AISI 06 steel discussed in 2.3, preceding. These materials are for study only, and are not included in the steels already specified for this facet of the program.

3.2 Heat Treatment and Metallurgy

3.2.1 All heat treatment has been accomplished on three cylinders each from E52100, 06, 1095 and 9261 steels (Reference the chart in Appendix I of the November Letter Report). Three cylinders each from W1 steel and high carbon, high phosphorus steel will be subjected to each of the applicable heat treatments shown in Columns 5 and 6 of the chart. Heat treatment of the latter is dependent upon the results of Chamberlain Corporation's metallurgical studies. This will complete the heat treatments previously agreed upon. Remaining cylinders from all materials are being held pending selection of additional heat treatments by the Technical Supervisor.

3.2.2 Of the cylinders already heat treated, two from each heat treatment were used for fragmentation testing and the third is to be used for metallurgical studies. This procedure was discussed in detail in the November report. The third cylinder is cut to yield three each of the following rough specimens: tensile, Charpy, micro, bend and hardness. During the report period efforts centered on cutting the specimen blanks from the cylinders and machining the blanks into finished specimens. This work was in progress at the close of the report period.

CHAMBERLAIN CORPORATION - WATERLOO, IOWA

Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)

3.2.2.1 With the exception of Charpy specimens, Chamberlain Corporation is preparing and testing specimens for other metallurgical studies. This facility does not have a Charpy test machine which is certified for the full range of Charpy values, so machining of specimens per Drawing No. J7886-1F and testing were subcontracted. Chamberlain Corporation is machining tensile test bars to the dimensions shown on Drawing No. J7886-3F; and is grinding bend and hardness specimens, the former per Drawing No. J7886-2F. Work was begun on cutting and polishing micro specimens. By the end of the report period the specimens shown on Table 3 had been completed and were ready for testing.

TABLE 3

METALLURGICAL SPECIMENS COMPLETED AS OF 31 DECEMBER 1965

CODE NO.	SPECIMENS READY FOR TEST				
	TENSILE	BEND	CHARPY	HARDNESS	MICRO
A08	3	3	3	3	3
AA6	3	3	3	3	3
AC10	3	3	3	3	3
BA6	3	3	-1	-	3
BA8	3	3	3	3	-
CC8	3	3	3	3	3
CS6	2	3	-	-	-
CCS8	3	-	-	-	-
DA6	3	3	-	3	-
DA8	1	3	3	-	-
J08	3	3	3	3	-
JC8	3	3	3	-	-
JT11	2	3	3	-	3

NOTES:

¹ Blanks indicate specimen not finished.

CHAMBERLAIN CORPORATION - WATERLOO, IOWA

Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)

3.2.2.2 The subcontractor performing the machining and testing of Charpy specimens was advised that a copy of the certification on his Charpy tester would be required. The certification had not been received at the time this report was written.

3.3 Fragmentation Testing

3.3.1 Fragmentation testing was completed on two cylinders from each heat treatment of E52100, 06, 1095 and 9261 steels. The fragments have been weighed and counted, and the data are presented in Appendix II for review and information. No conclusions or recommendations are offered pending test firings of the other two steels in the program and consultations with the Technical Supervisor on desired objectives.

3.3.1.1 A note is considered necessary with regard to the two cylinders grouped under Code A06R on the sheets in Appendix II. This was a repeat heat treatment and test of Code A06. The hardness of the A06 cylinders (Rockwell "C" 53 average) was regarded as low, and when these were fired the number of fragments recovered appeared to be low in comparison to other shots. Consequently, it was decided to re-shoot the test, using two cylinders heat treated the same as the original A06. The second set of cylinders was Rockwell "C" 57, slightly higher than that for A06. Fragmentation data were approximately similar (Reference Appendix II).

3.3.2 When heat treated cylinders are available from the WI and high carbon, high phosphorus steels, testing will commence on these items.

3.4 Machining Studies

3.4.1 No work was performed on this part of the program during the report month.

4. PROJECTILES

4.1 Specifications and Inspection Equipment

4.1.1 On 15 December 1965 a draft copy of a Purchase Description for the XM570 was given to a representative of Picatinny Arsenal for hand-carrying to the Technical Supervisor for his review and information.

CHAMBERLAIN CORPORATION - WATERLOO, IOWA

Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)

- 4.1.2 The gage designs completed during the report period are listed in Appendix I. Copies of the drawings are not included in this report. These drawings, which are for the XM502, were finished near the end of November 1965; however, review and approval by the Quality Control Department was completed during December.
- 4.2 Process Development
- 4.2.1 No activity was expended on process development. Tool design and fabrication for hot press work has progressed to the point where further effort depends on a firm decision on projectile design.
- 4.3 Banding Studies
- 4.3.1 A quotation was received from the other quoting company on broach tooling for cutting the teeth on the XM570 rotating band. As with other quotations, delivery was projected at 14 to 18 weeks after receipt of an order.
5. HOURS
- 5.1 The following tabulation shows the hours expended during the report period and also the cumulative hours to 31 December 1965.

	<u>December 1965</u>	<u>Cumulative</u>
Engineering	189.1	1,980.1
Drafting	91.4	459.0
Laboratory Testing	9.0	58.2
Shop (Prod. & Proc.)	183.3	779.1
Shop (Tooling)	128.1	406.5
Inspection (Tooling & Prod.)	13.5	37.2
Performance Testing	208.7	268.2
Reports	58.5	233.5
Gage Engineering	131.9	321.2
	<hr/>	<hr/>
TOTALS	1,013.5	4,543.0

CHAMBERLAIN CORPORATION - WATERLOO, IOWA

Sixth Monthly Letter Report - December 1965
Contract DA-28-017-AMC-2308(A)

6. PLANNING

6.1 January 1966

6.1.1 Heat treatment and testing of cylinders will continue, based on conclusions from review of data from initial tests and on decisions pertaining to heat treatment selection. Metallurgical tests of samples from cylinders of high carbon, high phosphorus steel will determine if the material being held at the mill will be ordered.

6.1.2 Process development will begin for either the XM502 or the XM570, provided that selection of design and material is made.

6.1.3 Machinability tests will proceed using the method outlined in the November 1965 progress report.

6.2 February 1966

6.2.1 Heat treatment and testing of cylinders will continue with variations selected by the Technical Supervisor.

6.2.2 Shell process development will continue.

6.2.3 Machinability tests will be continued during February for any additional heat treatments selected.

Very truly yours,

CHAMBERLAIN CORPORATION

Irving Herman

Irving Herman
Vice President
Ordnance Division

db

APPENDIX I

ILLUSTRATIONS



100X

POLISHED

100X

3% NITAL ETCH



PHOTO NO. 7284

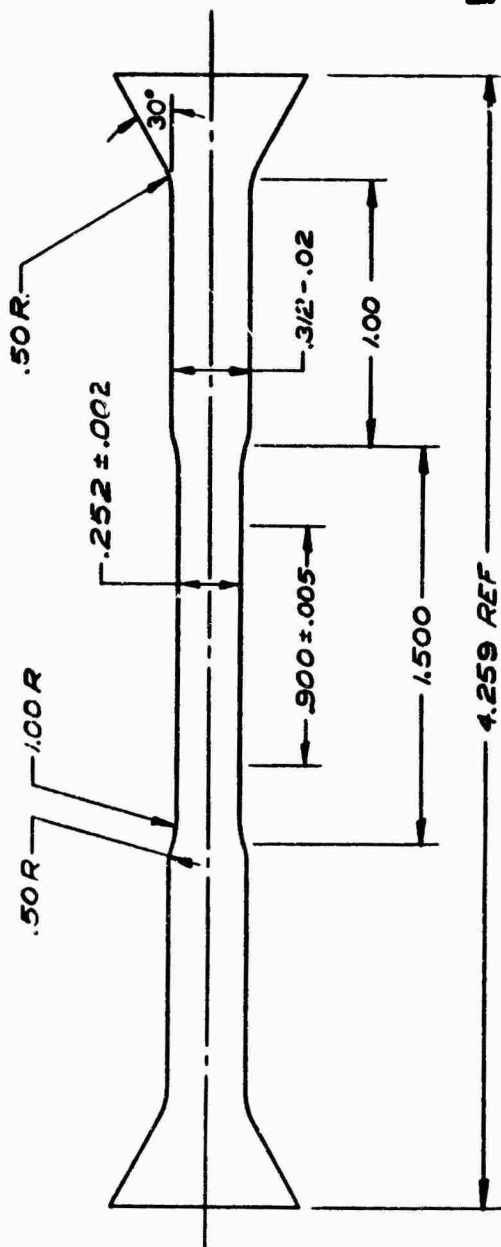
PHOTOMICROGRAPHS OF SAMPLE FROM CENTER OF 4.0 INCHES DIAMETER BAR OF HIGH CARBON, HIGH PHOSPHORUS STEEL.

NOTES:

Structure Is Spheroidized, But Shows Evidence Of Breakdown. The Black Spots, Some Connected By Black Lines, Appear To Be Breakdown Of The Grain Boundaries. The Light Area In The Etch Photo Appears To Be Phosphorus Segregation. These Conditions Noted Throughout The 10 Feet Length Of The Bar.

CHAMBERLAIN CORPORATION

DATE USED ON	DATE
DRIVEN	1/2/85
PLATED	
CHASSIS	DWL
APPROVED	
SCALE	3/1
DATE OF PRINT	
DISTROY PREVIOUS ISSUES	
	U7886-3F



**DRAWING NOT TO SCALE
DUE TO REDUCTION PROCESS**

UNLESS OTHERWISE SPECIFIED LIMITS ARE	AS	± .005
	IN	± .010
AMERICAN	AS	± .005
	IN	± .010
Name TENSILE SPECIMEN		
Material		
CHAMBERLAIN <i>Corporation</i> WATERLOO, IOWA		

J7886-3F

NOTES:

1. DIAMETER OF THE REDUCED SECTION MAY BE SMALLER AT CENTER THAN AT ENDS. DIFFERENCE SHALL NOT EXCEED .002.
2. WHEN AN EXTENSIONMETER IS REQUIRED TO DETERMINE ELASTIC PROPERTIES, LENGTH OF REDUCED SECTION AND OVERALL LENGTH MAY BE MODIFIED TO PROVIDE THEREFORE. IN ALL CASES THE PERCENTAGE OF ELONGATION SHALL BE BASED ON .900 INCHES.
3. ENDS MAY BE OF ANY SHAPE TO FIT THE HOLDERS OF THE TESTING MACHINE IN SUCH A MANNER THAT THE LOAD IS AXIAL.

CONTRACT DA-28-017-AMC-2308(A)

LIST OF GAGE DRAWINGS
COMPLETED
DURING DECEMBER 1965

DRAWING NUMBER	DESCRIPTION
J7886-18D	Pitch diameter of base thread, minimum
J7886-20D	Pitch diameter of base thread, maximum and minimum length of thread
J7886-38D	Set plug for J7886-20D
J7886-39D	Set plug for J7886-18D
J7886-40D	Major diameter of base thread, minimum
J7886-42D	Width of band seat
J7886-53D	Width of band groove
J7886-70D	Concentricity of major diameter of rotating band with bourrelet diameter at front and rear of band (straight spline)
J7886-71D	Concentricity of major diameter of rotating band with bourrelet diameter at front and rear of band (helix spline)
J7886-71D-S	Acceptance check for J7886-71D

APPENDIX II

FRAGMENT DATA

AISI E52100

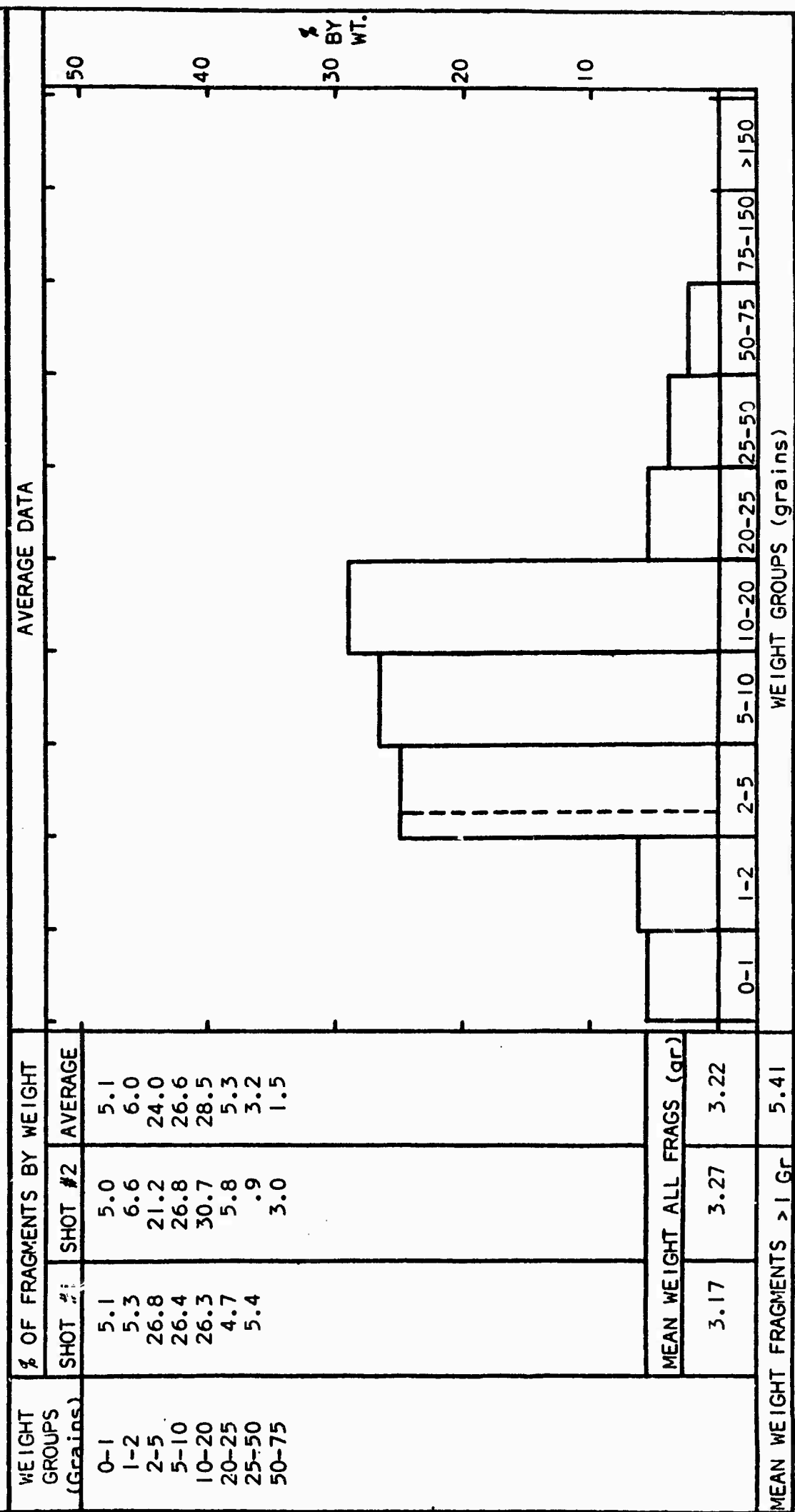
STEEL

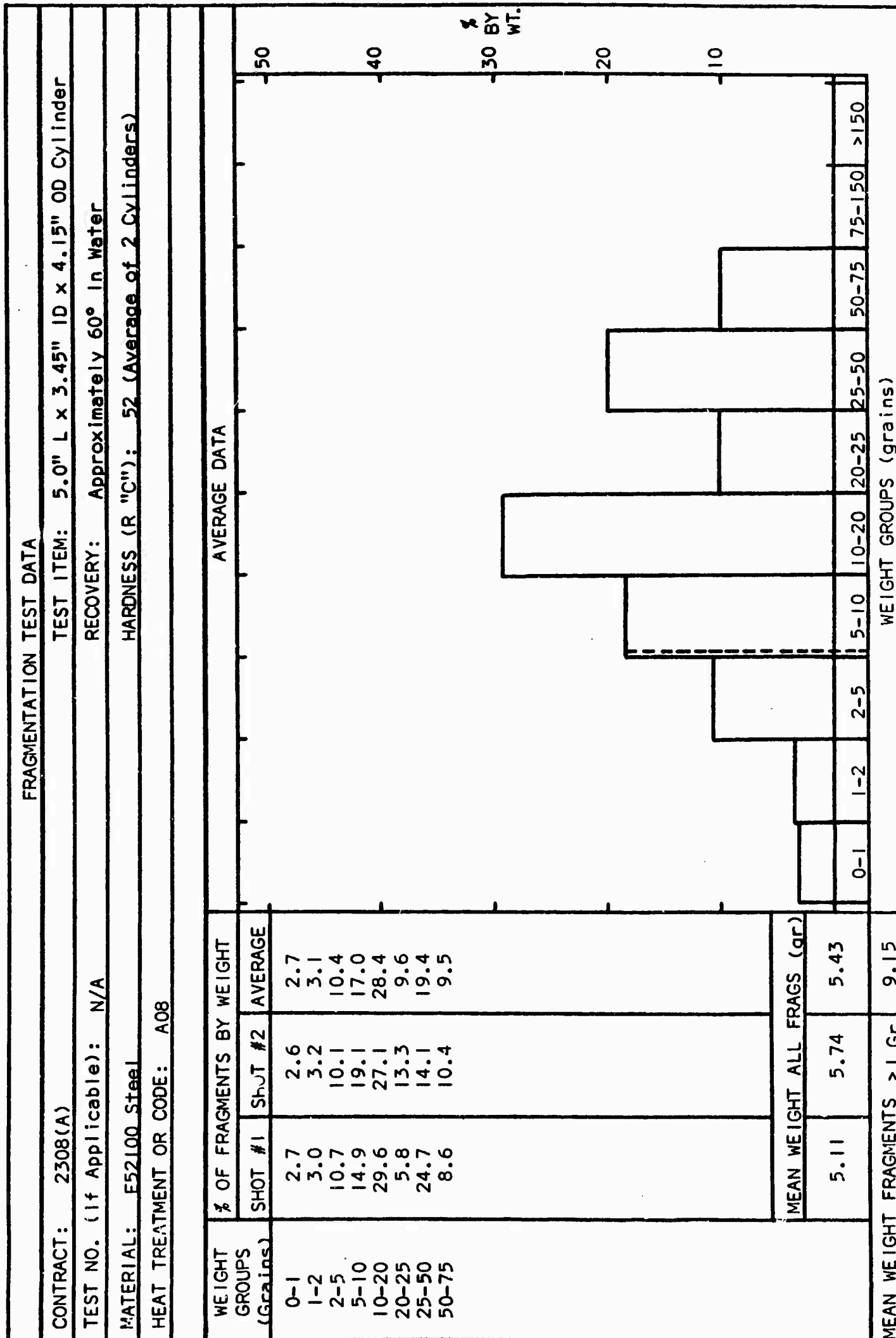
FRAGMENTATION TEST DATA			
CONTRACT:	2308(A)	TEST ITEM:	5.0" I x 3.45" ID x 4.15" OD Cylinder
TEST NO. (If Applicable):	N/A	RECOVERY:	Approximately 60° In Water
MATERIAL:	F52100 Steel	HARDNESS (R "C"):	53 (Average of 2 Cylinders)
HEAT TREATMENT OR CODE:	A06		

WEIGHT GROUPS (Grains)	% OF FRAGMENTS BY WEIGHT			AVERAGE DATA
	SHOT #1	SHOT #2	AVERAGE	
0-1	7.5	4.3	5.9	
1-2	8.3	5.4	6.9	
2-5	26.1	18.6	22.4	
5-10	24.9	27.2	26.1	
10-20	23.9	24.2	24.1	
20-25	4.5	5.4	5.0	
25-50	4.7	7.9	6.3	
50-75		0	0	
75-150		6.9	3.5	
MEAN WEIGHT ALL FRAGS (gr)				
2.56			3.67	3.12
MEAN WEIGHT FRAGMENTS > 1 GR			5.47	

FRAGMENTATION TEST DATA

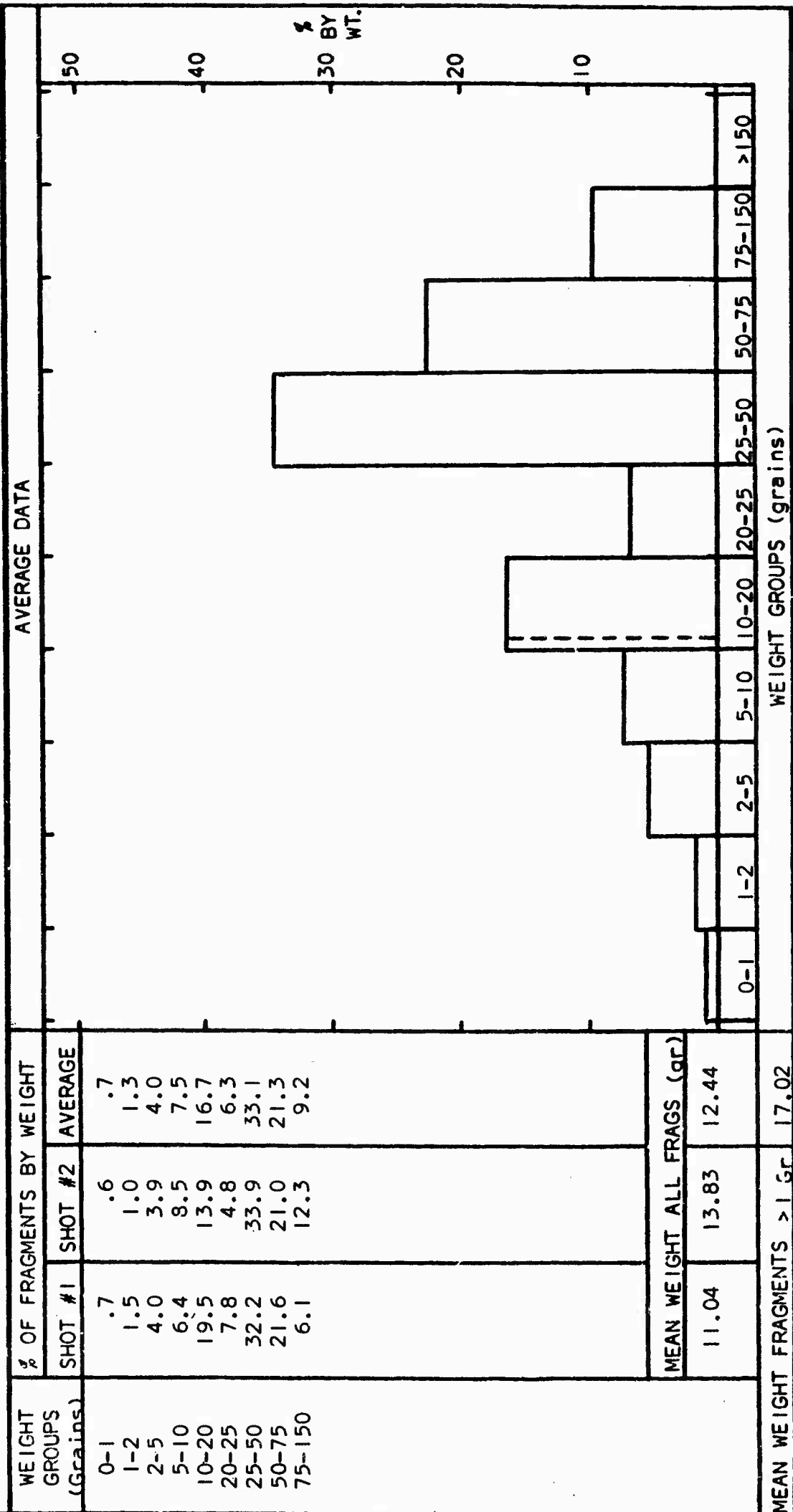
CONTRACT:	2308(A)	TEST ITEM:	5.0" L x 3.45" ID x 4.15" OD Cylinder
TEST NO. (If Applicable):	N/A	RECOVERY:	Approximately 60° In Water
MATERIAL:	E52100 Steel	HARDNESS (R "C"):	57 (Average of 2 Cylinders)
HEAT TREATMENT OR CODE:	A06R		

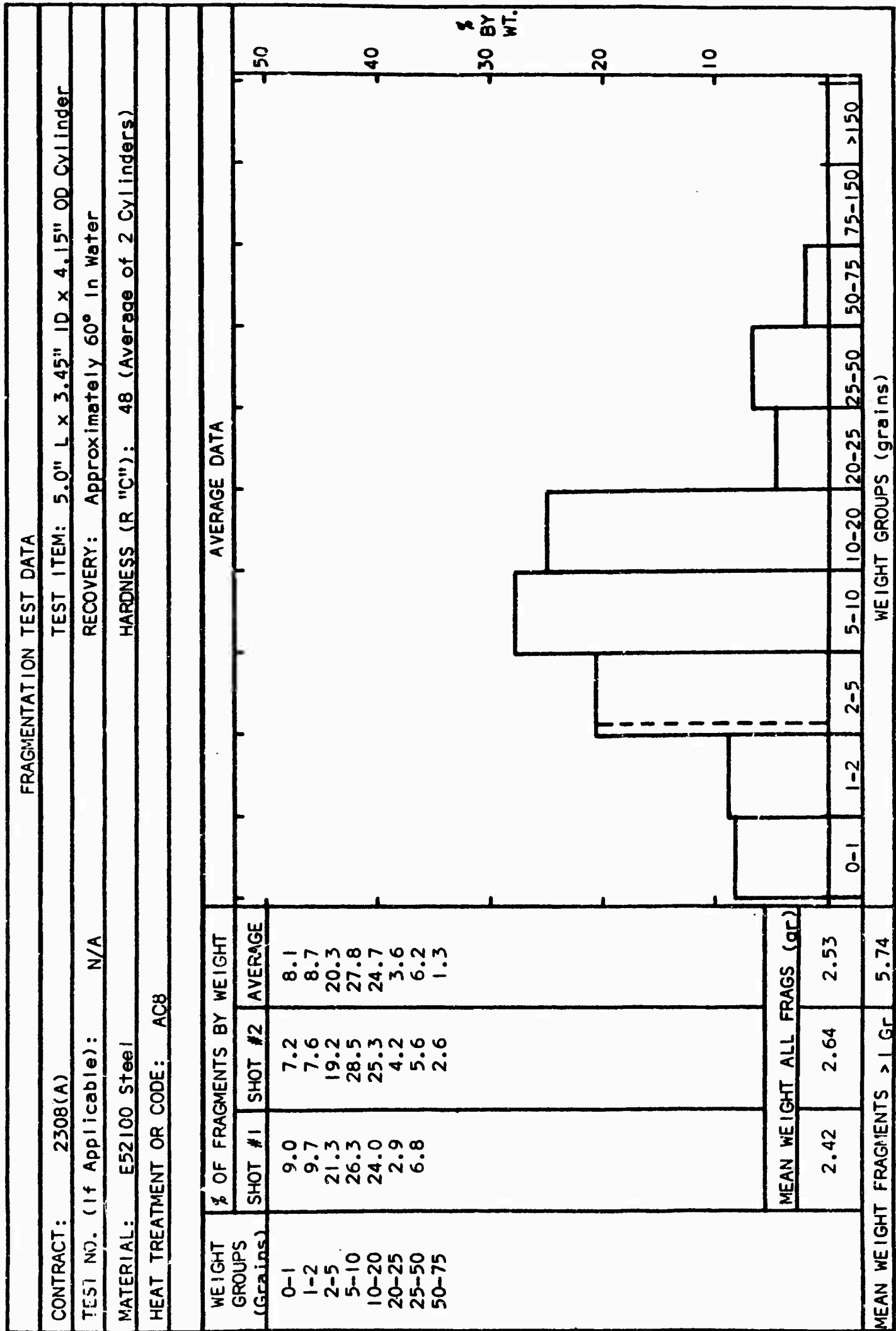




FRAGMENTATION TEST DATA										
CONTRACT: 2308(A)		TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder								
TEST NO. (If Applicable):		N/A		RECOVERY: Approximately 60° In Water						
MATERIAL: E52100 Steel		HARDNESS (R "C"): 38 (Average of 2 Cylinders)								
HEAT TREATMENT OR CODE: AA6										
		AVERAGE DATA								
WEIGHT GROUPS (Grains)	% OF FRAGMENTS BY WEIGHT									
	SHOT #1	SHOT #2	AVERAGE							
0-1	1.7	.7	1.2							
1-2	1.5	.8	1.2							
2-5	6.6	4.9	5.8							
5-10	9.3	7.1	8.2							
10-20	21.9	14.7	18.3							
20-25	14.0	7.3	10.7							
25-50	31.8	19.6	25.7							
50-75	9.5	21.9	15.7							
75-150	3.6	22.8	13.2							
MEAN WEIGHT ALL FRAGS (gr)										
7.74				12.41	10.08					
MEAN WEIGHT FRAGMENTS > 1 Gr				15.54						

FRAGMENTATION TEST DATA			
CONTRACT:	2308(A)	TEST ITEM:	5.0" L x 3.45" ID x 4.15" OD Cylinder
TEST NO. (If Applicable):	N/A	RECOVERY:	Approximately 60% In Water
MATERIAL:	F52100 Steel	HARDNESS (R "C"):	38 (Average of 2 Cylinders)
HEAT TREATMENT OR CODE: AA8			

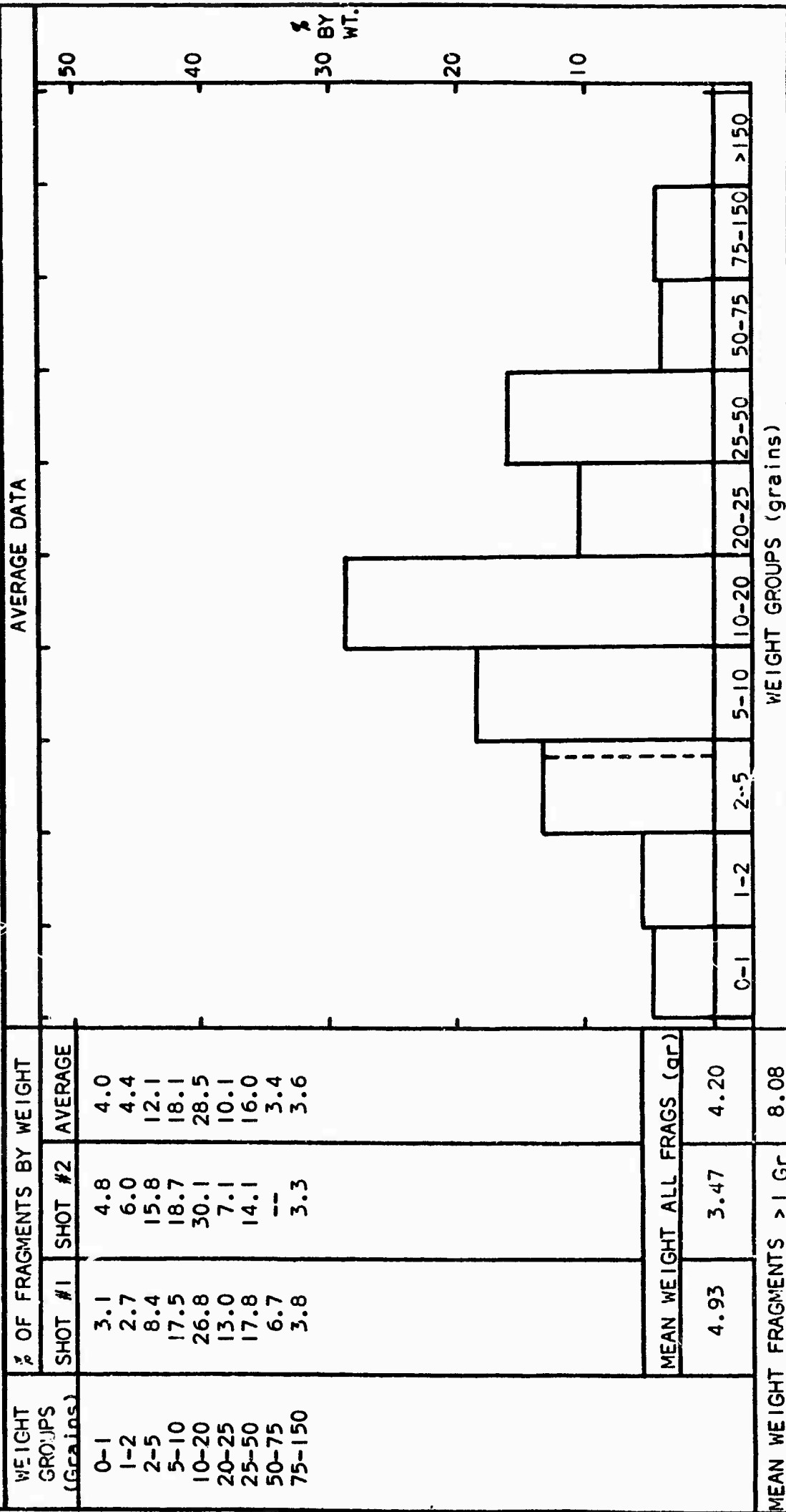


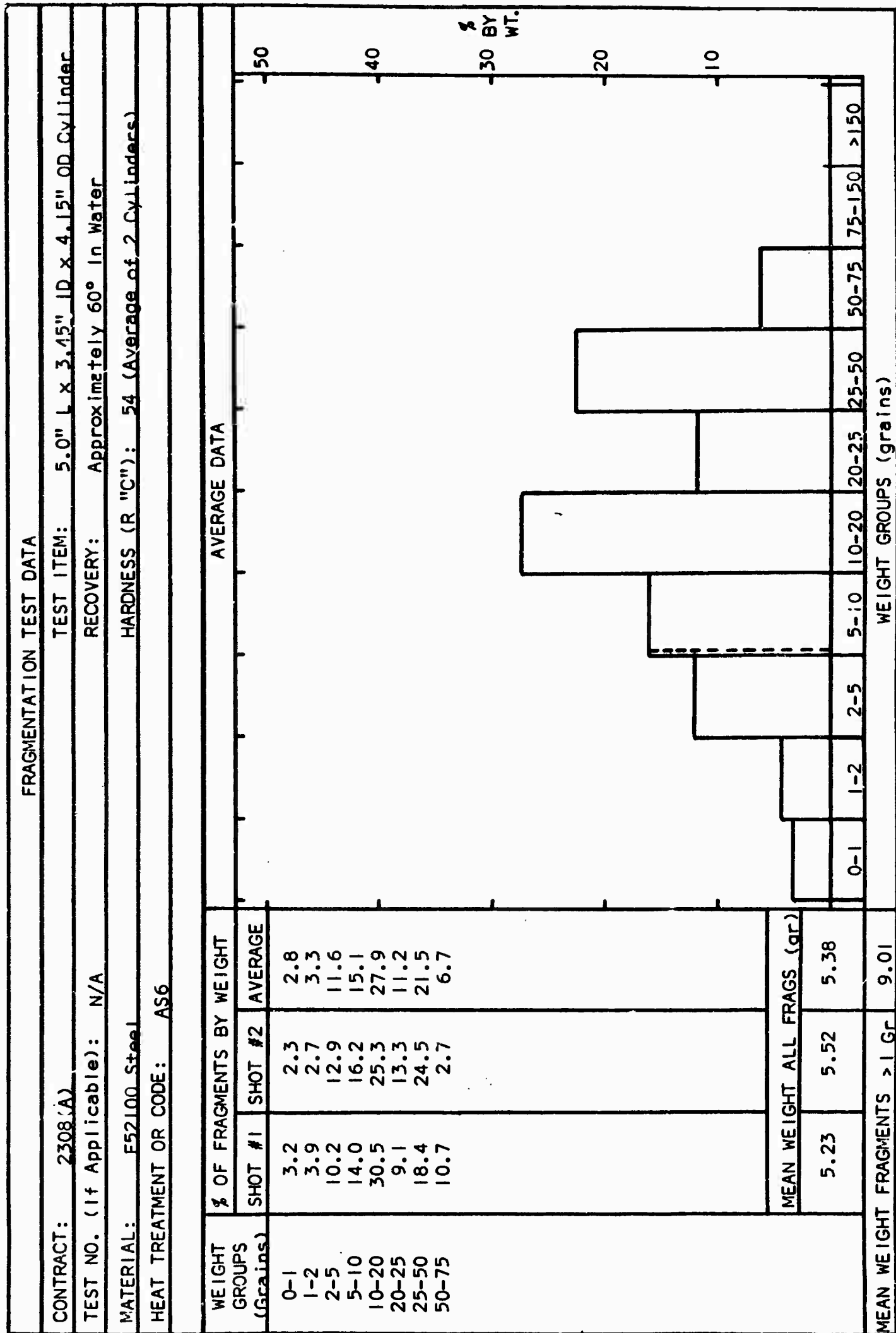


FRAGMENTATION TEST DATA

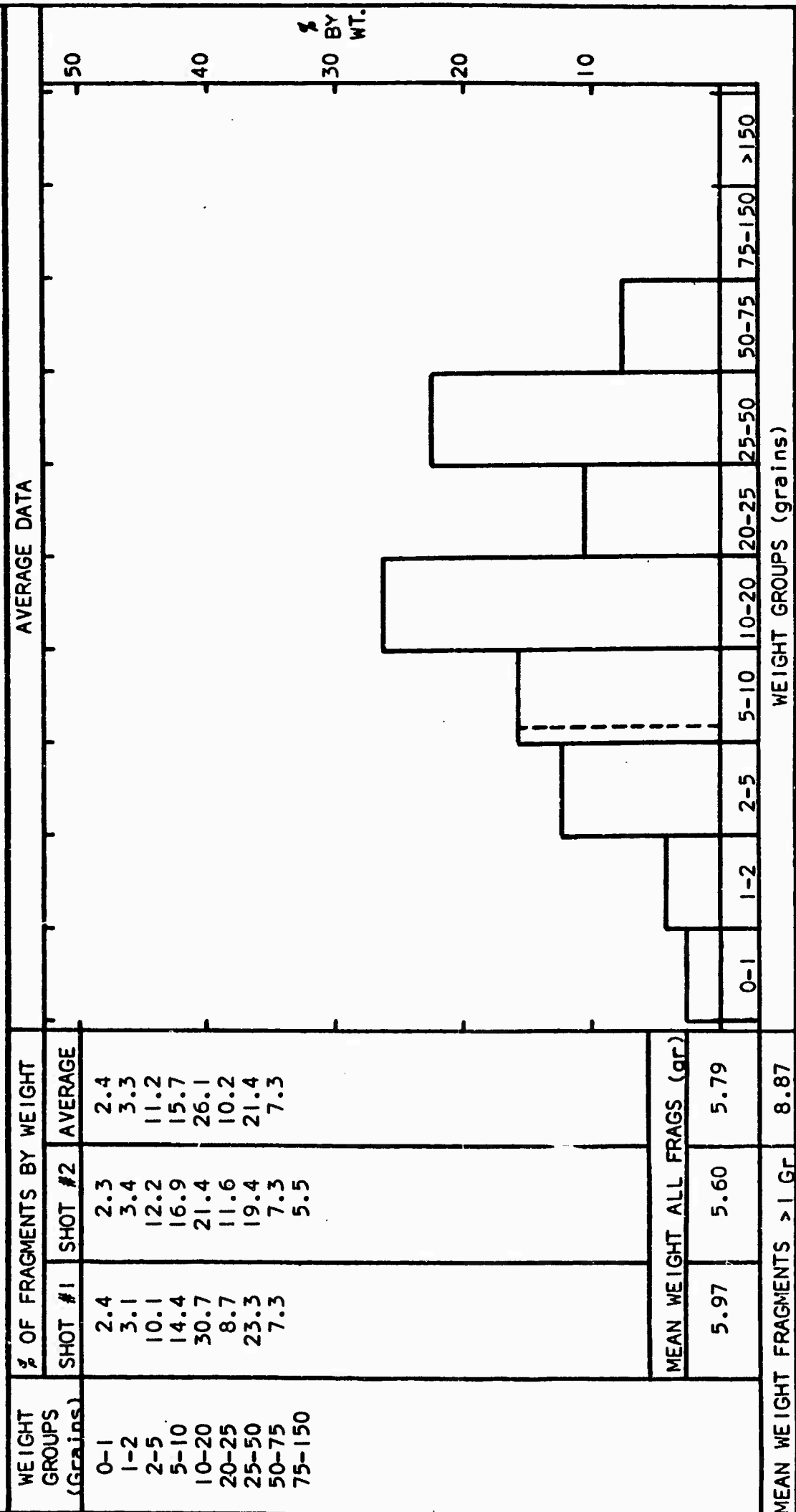
CONTRACT: 2308(A) TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder
 TEST NO. (If Applicable): N/A RECOVERY: Approximately 60° In Water
 MATERIAL: E52100 Steel HARDNESS (R "C"): 42 (Average of 2 Cylinders)
 HEAT TREATMENT OR CODE: AC10

AVERAGE DATA



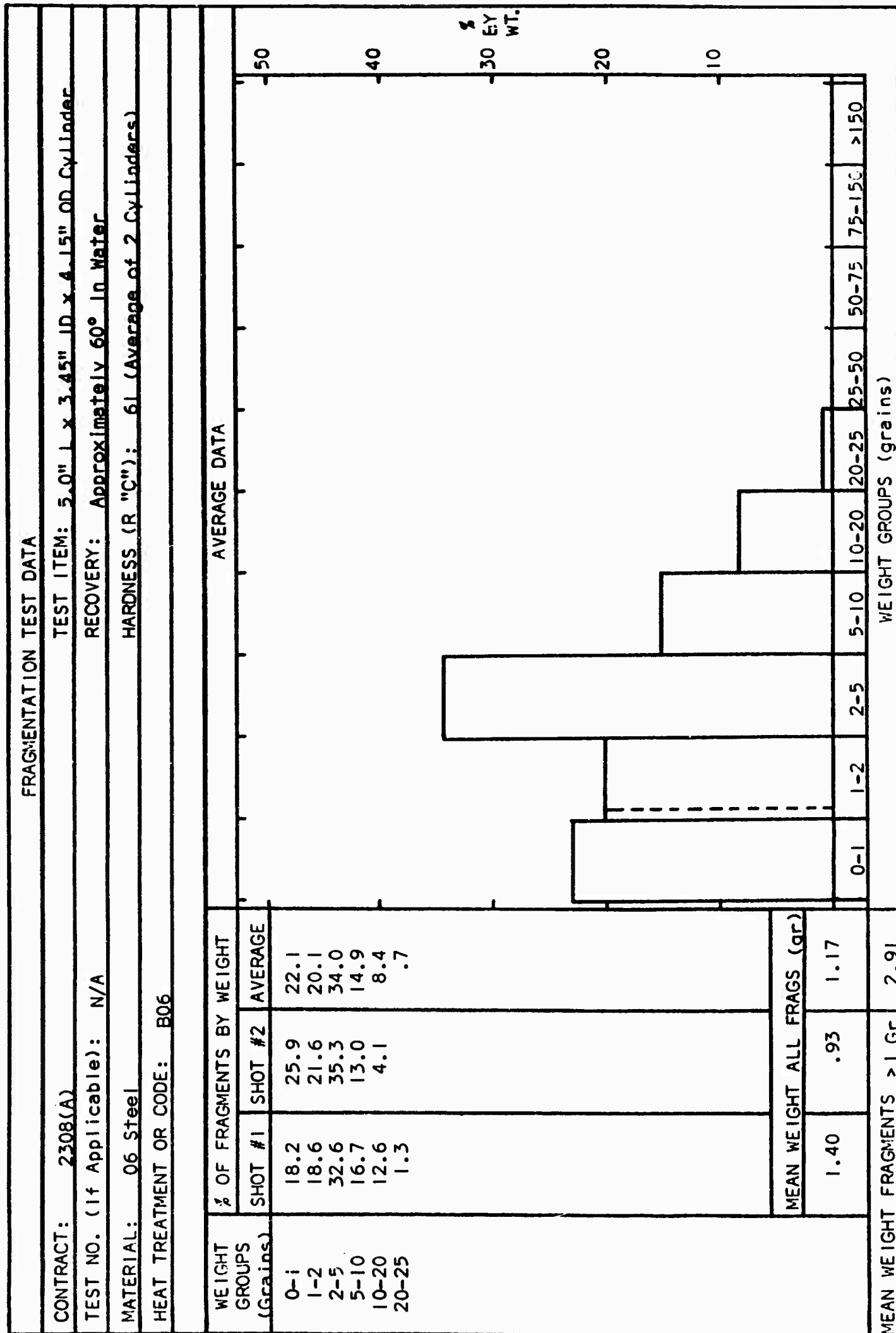


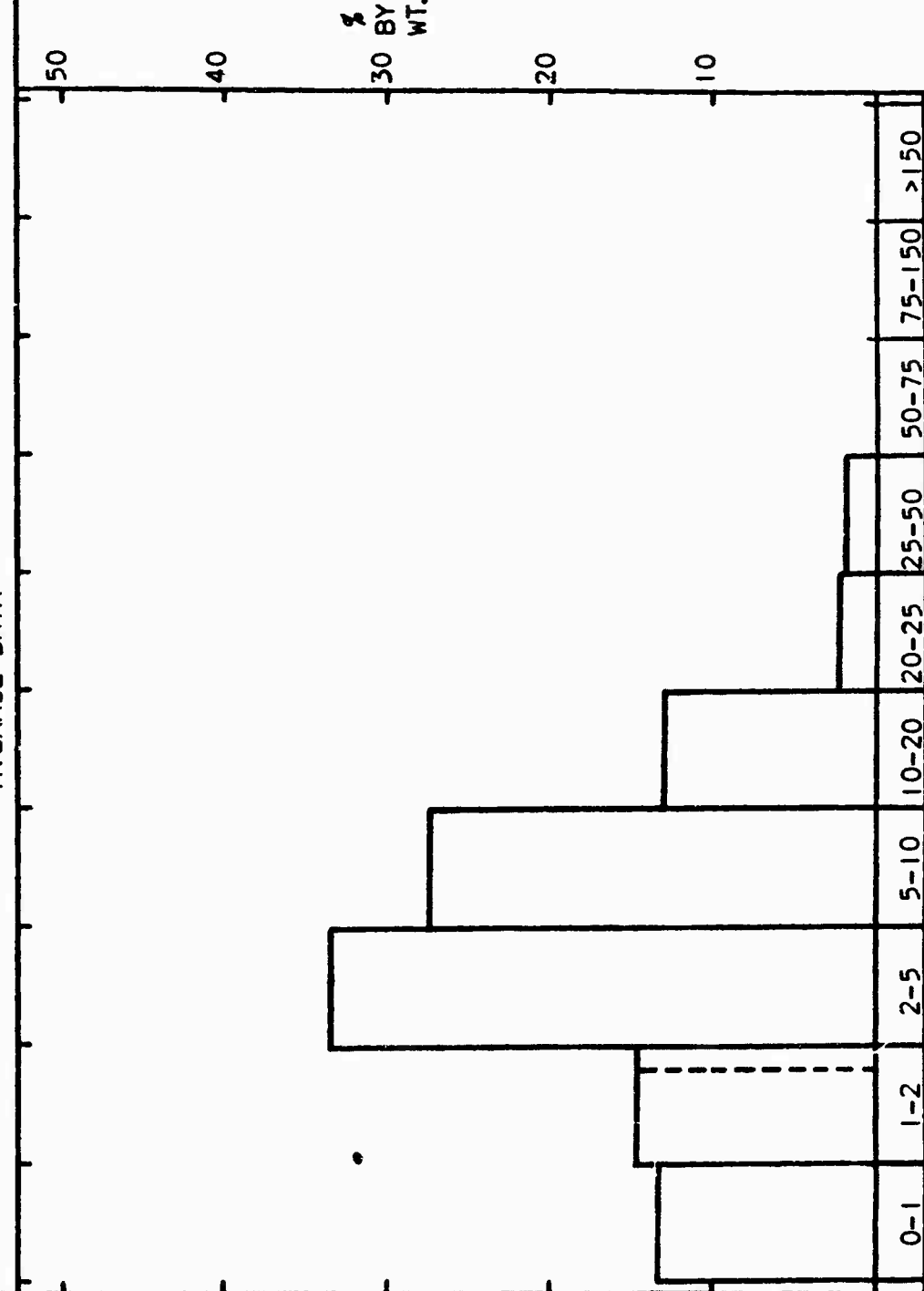
FRAGMENTATION TEST DATA			
CONTRACT:	2308(A)	TEST ITEM:	5.0" L x 3.45" ID x 4.15" OD Cylinder
TEST NO. (If Applicable):	N/A	RECOVERY:	Approximately 60° In Water
MATERIAL:	E52100 Steel	HARDNESS (R "C"):	51 (Average of 2 Cylinders)
HEAT TREATMENT OR CODE:	ACS8		



AISI 06

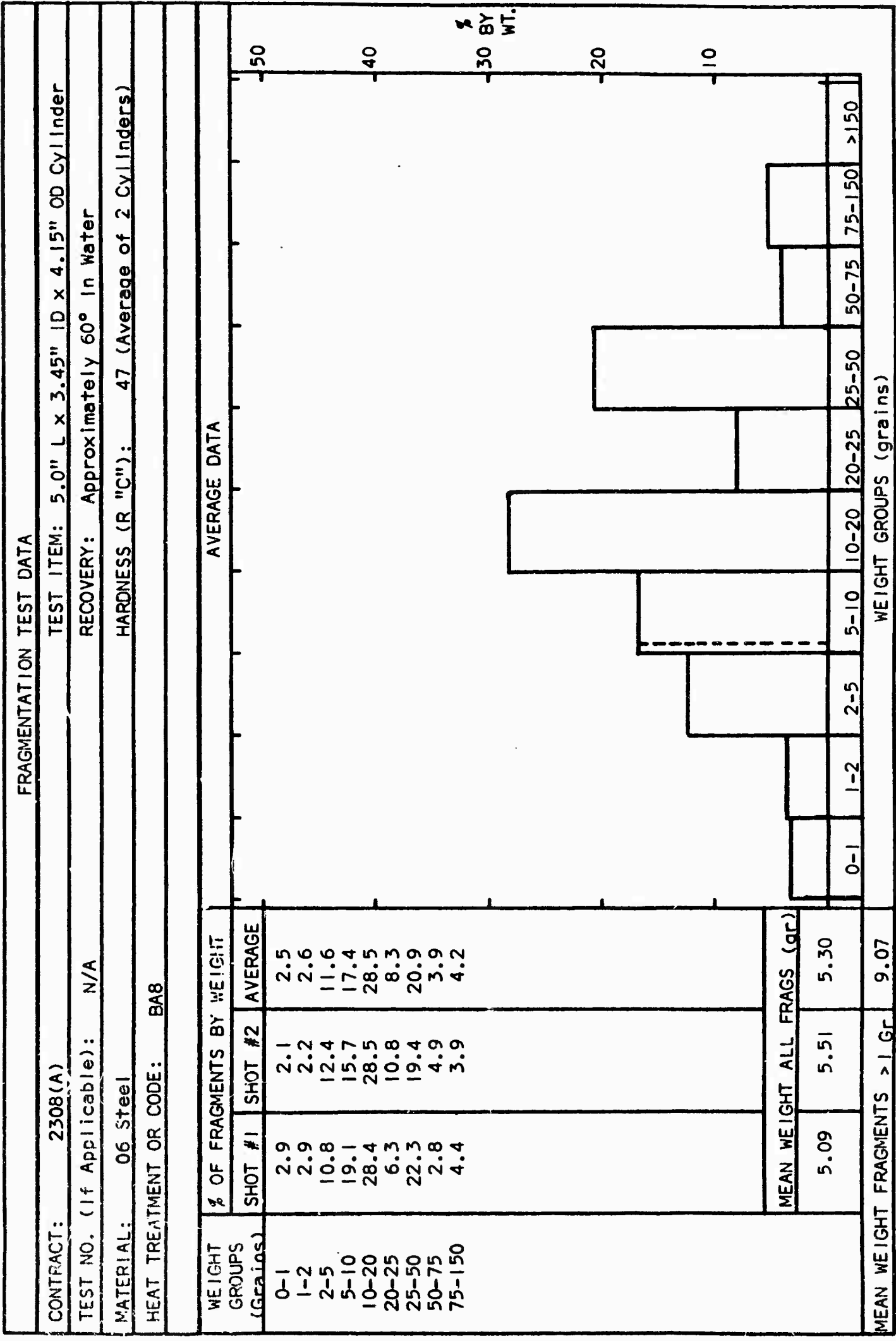
STEEL

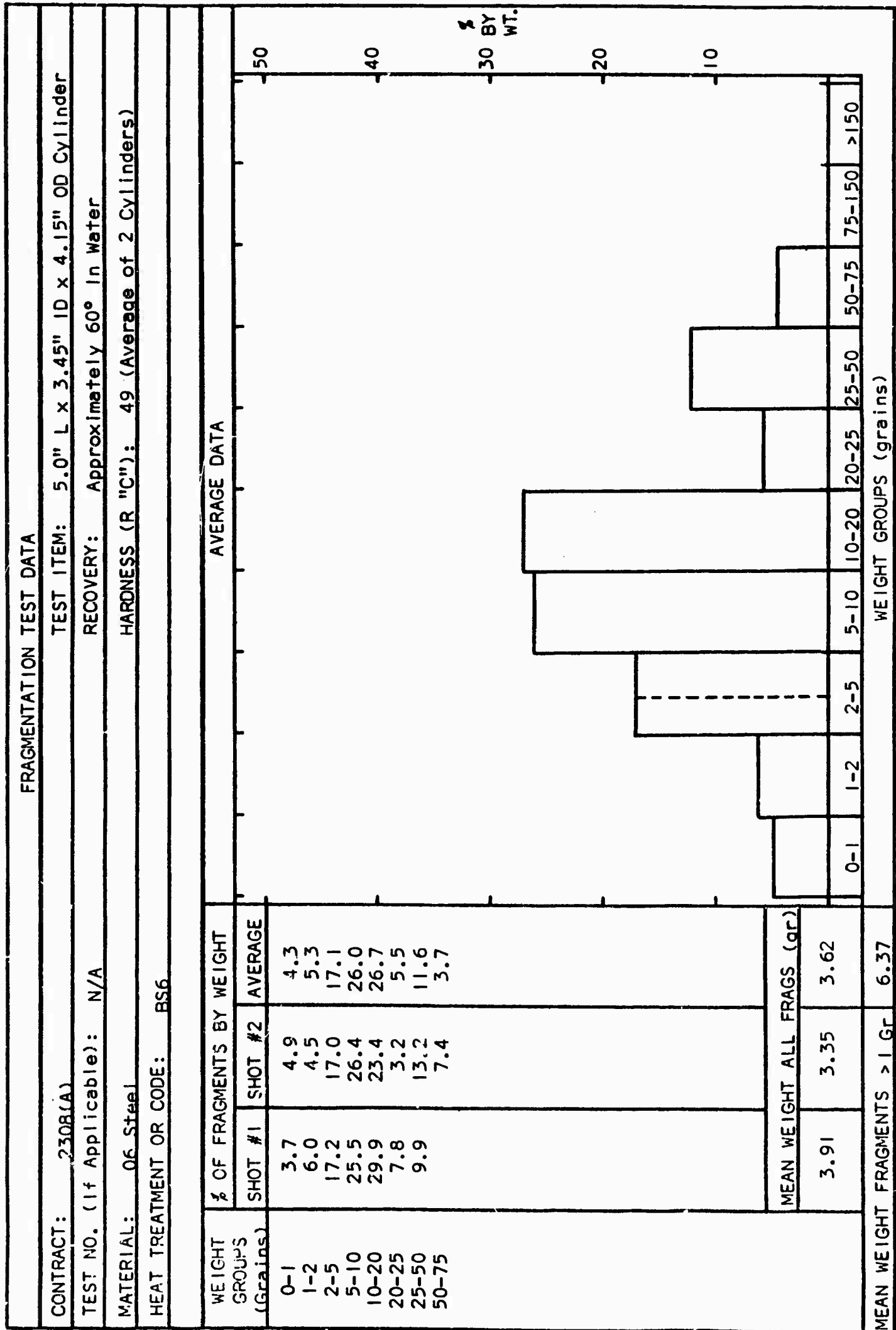


FRAGMENTATION TEST DATA				
CONTRACT:	2308(A)	TEST ITEM:	5.0" L x 3.45" ID x 4.15" OD Cylinder	
TEST NO. (If Applicable):	N/A	RECOVERY:	Approximately 60° In Water	
MATERIAL:	06 Steel	HARDNESS (R "C"):	55 (Average of 2 Cylinders)	
HEAT TREATMENT OR CODE:		B08		
AVERAGE DATA				
WEIGHT GROUPS (Grains)	% OF FRAGMENTS BY WEIGHT			
	SHOT #1	SHOT #2	AVERAGE	
0-1	15.4	9.3	12.4	
1-2	15.9	11.6	13.8	
2-5	34.7	31.0	32.9	
5-10	23.9	30.0	27.0	
10-20	8.9	15.1	12.0	
20-25	1.1	1.3	1.2	
25-50		1.7	.9	
MEAN WEIGHT ALL FRAGS (gr)				
	1.39	2.00	1.70	
MEAN WEIGHT FRAGMENTS > 1 Gr			3.61	

FRAGMENTATION TEST DATA			
CONTRACT: 2308(A)		TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder	
TEST NO. (If Applicable): N/A		RECOVERY: Approximately 60° In Water	
MATERIAL: 06 Steel		HARDNESS (R "C"): 45 (Average of 2 Cylinders)	
HEAT TREATMENT OR CODE: BA6			

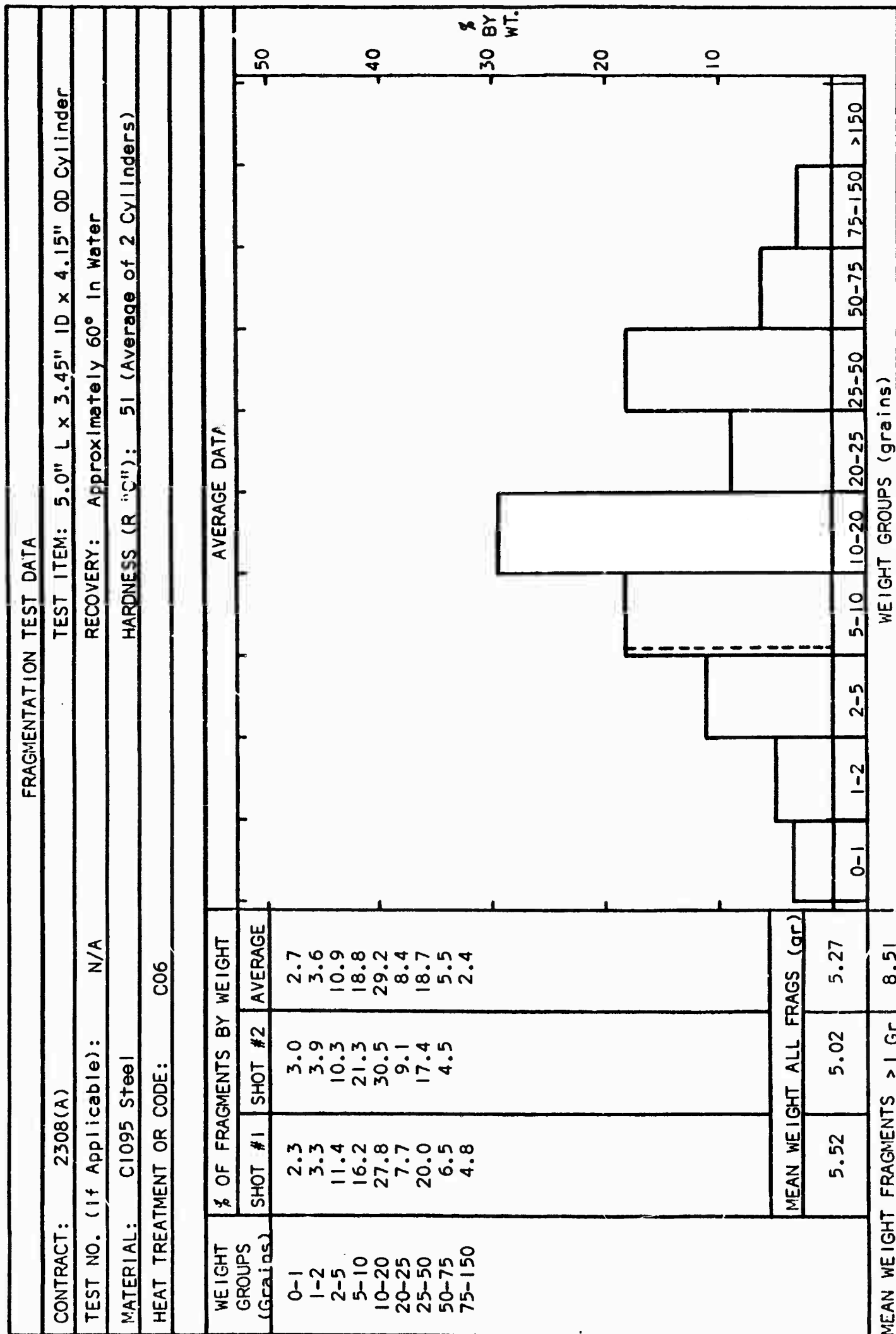
WEIGHT GROUPS (Grains)	% OF FRAGMENTS BY WEIGHT			AVERAGE DATA
	SHOT #1	SHOT #2	AVERAGE	
0-1	7.6	4.9	6.2	
1-2	8.5	5.8	7.2	
2-5	29.1	24.0	26.6	
5-10	25.7	28.9	27.3	
10-20	22.5	28.4	25.5	
20-25	2.1	4.2	3.2	
25-50	4.4	3.7	4.1	
MEAN WEIGHT ALL FRAGS (gr)				
2.39	3.11	2.75		
MEAN WEIGHT FRAGMENTS > 1 Gr			4.90	





CI095

STEEL



FRAGMENTATION TEST DATA										
CONTRACT: 2308(A)		TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder								
TEST NO. (If Applicable):		N/A		RECOVERY: Approximately 60° In Water						
MATERIAL: C1095 Steel		HARDNESS (R "C"): 51 (Average of 2 Cylinders)								
HEAT TREATMENT OR CODE: C08										
AVERAGE DATA										
WEIGHT GROUPS (Grains)	% OF FRAGMENTS BY WEIGHT									
	SHOT #1	SHOT #2	AVERAGE							
0-1	.9	.9	.9							
1-2	1.4	1.5	1.5							
2-5	5.8	2.9	4.4							
5-10	11.9	6.4	9.2							
10-20	19.0	15.5	17.3							
20-25	6.1	4.1	5.1							
25-50	20.2	25.9	23.1							
50-75	16.5	20.3	18.4							
75-150	18.2	15.3	16.8							
> 150		7.2	3.6							

FRAGMENTATION TEST DATA

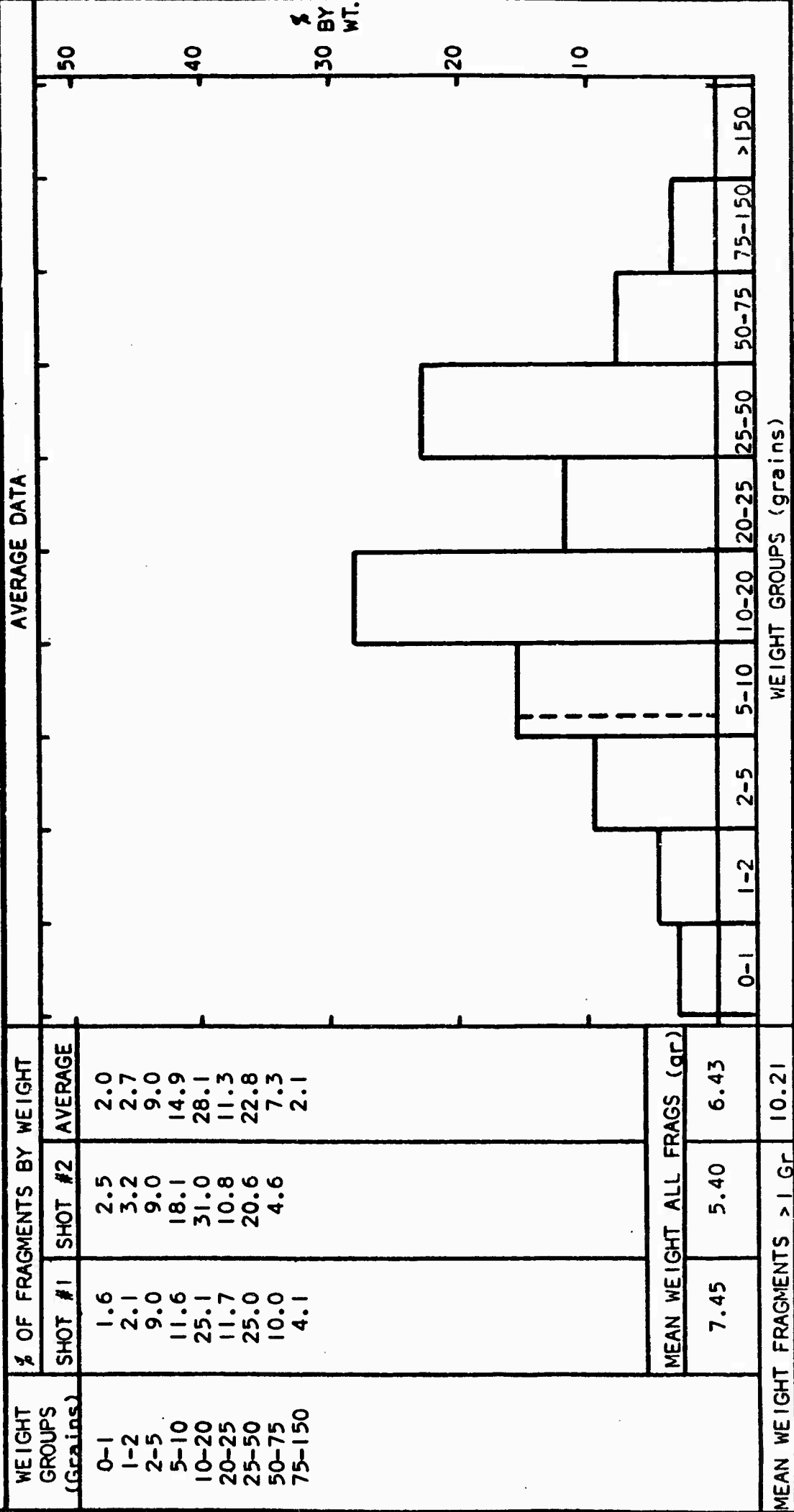
CONTRACT: 2308(A) TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder

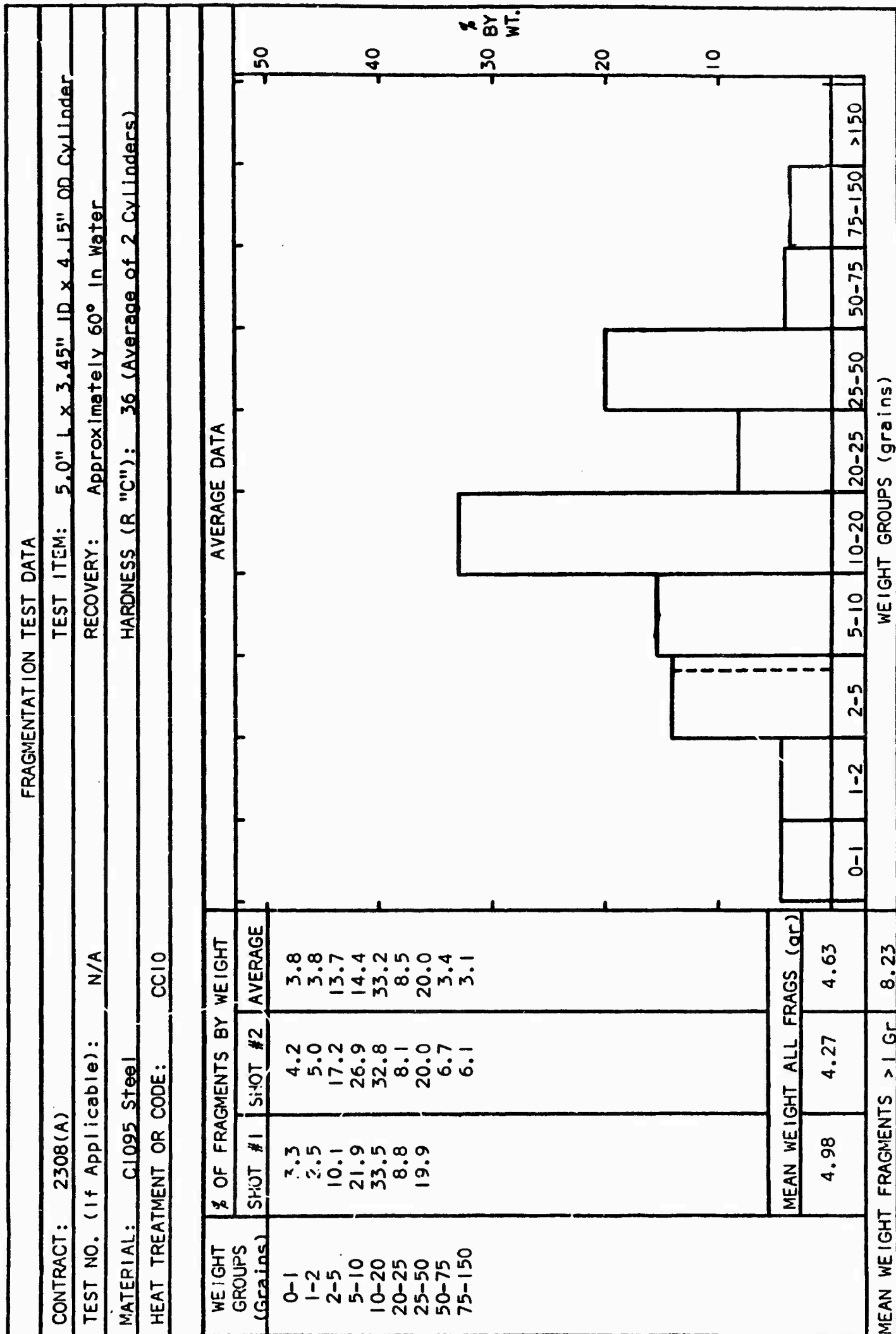
TEST NO. (If Applicable): N/A RECOVERY: Approximately 60% In Water

MATERIAL: C1095 Steel HARDNESS (R "C"): 35 (Average of 2 Cylinders)

HEAT TREATMENT OR CODE: CC8

AVERAGE DATA





FRAGMENTATION TEST DATA										
CONTRACT: 2308(A)		TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder								
TEST NO. (If Applicable): N/A		RECOVERY: Approximately 60° In Water								
MATERIAL: C1025 Steel		HARDNESS (R "C"): 44 (Average of 2 Cylinders)								
HEAT TREATMENT OR CODE: CS6										
AVERAGE DATA										
WEIGHT GROUPS (Grains)	% OF FRAGMENTS BY WEIGHT									
	SHOT #1	SHOT #2	AVERAGE							
0-1	.7	1.1	.9							
1-2	.8	1.3	1.1							
2-5	2.6	3.9	3.3							
5-10	7.6	11.7	9.7							
10-20	14.7	17.9	16.3							
20-25	8.1	6.6	7.4							
25-50	22.0	27.3	24.7							
50-75	16.5	9.4	13.0							
75-150	21.0	20.8	20.9							
> 150	6.0		3.0							
</										

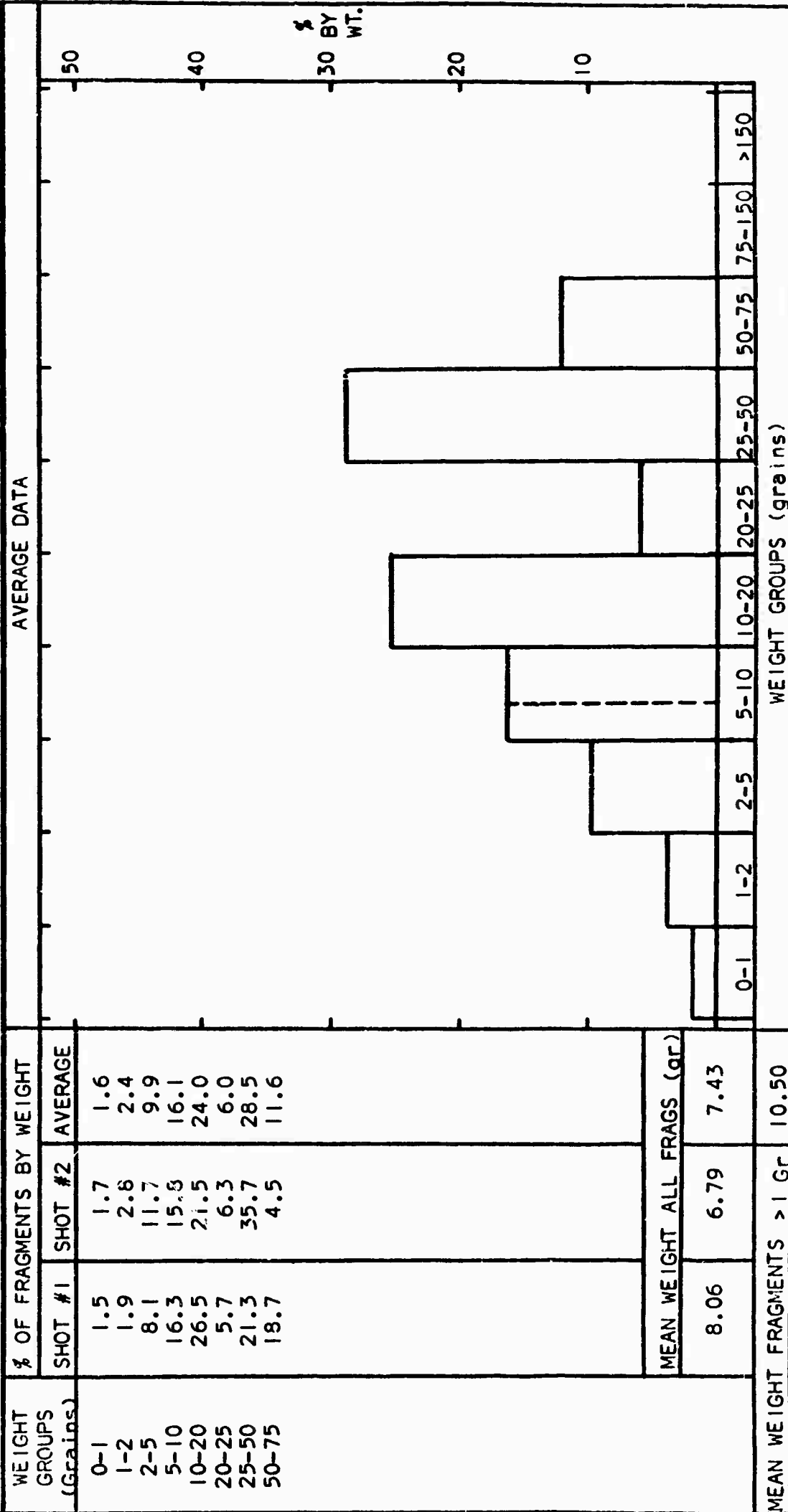
FRAGMENTATION TEST DATA

CONTRACT: 2308(A) TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder

TEST NO. (If Applicable): N/A RECOVERY: Approximately 60° In Water

MATERIAL: 21095 Steel HARDNESS (R "C"): 45 (Average of 2 Cylinders)

HEAT TREATMENT OR CODE: CCS8

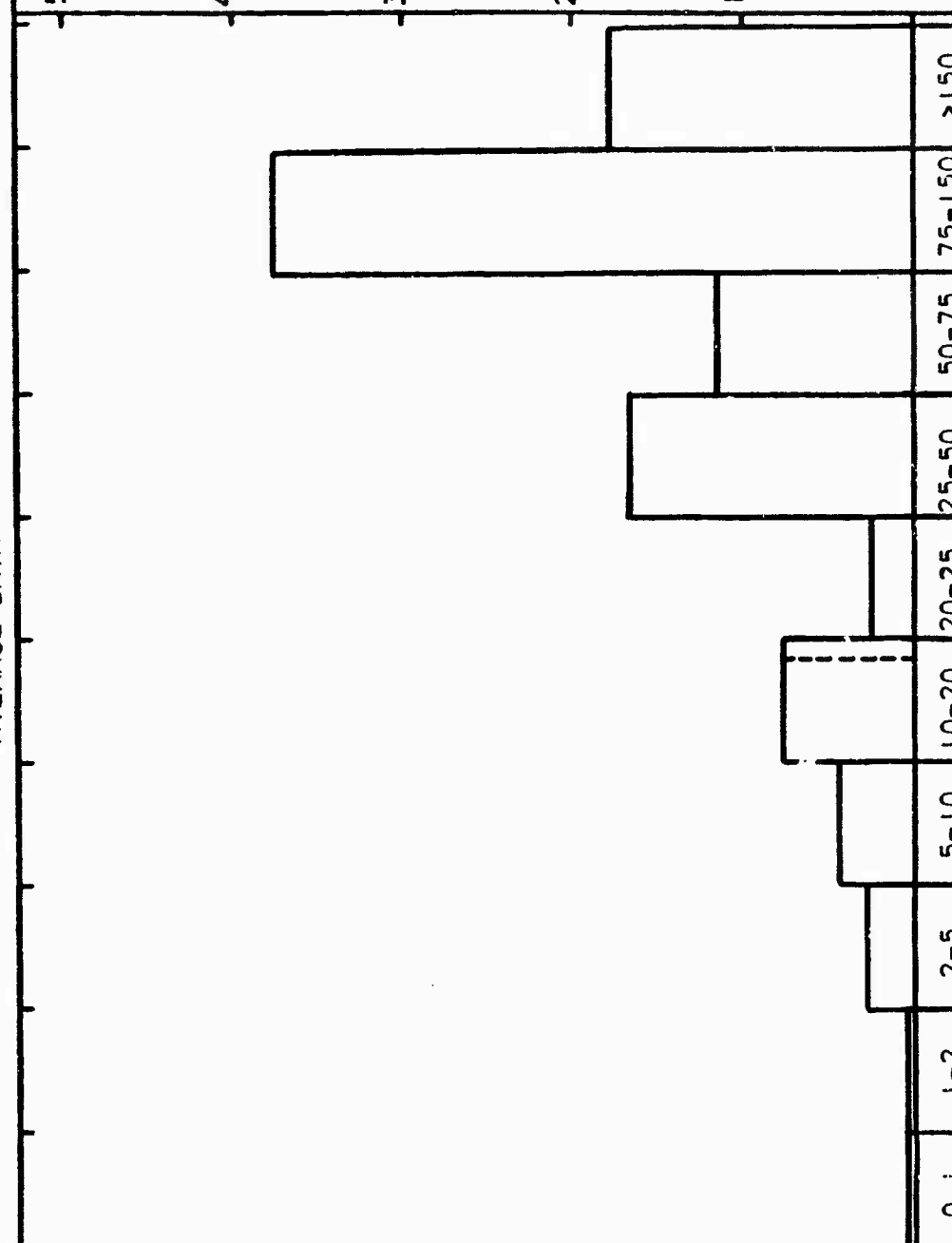


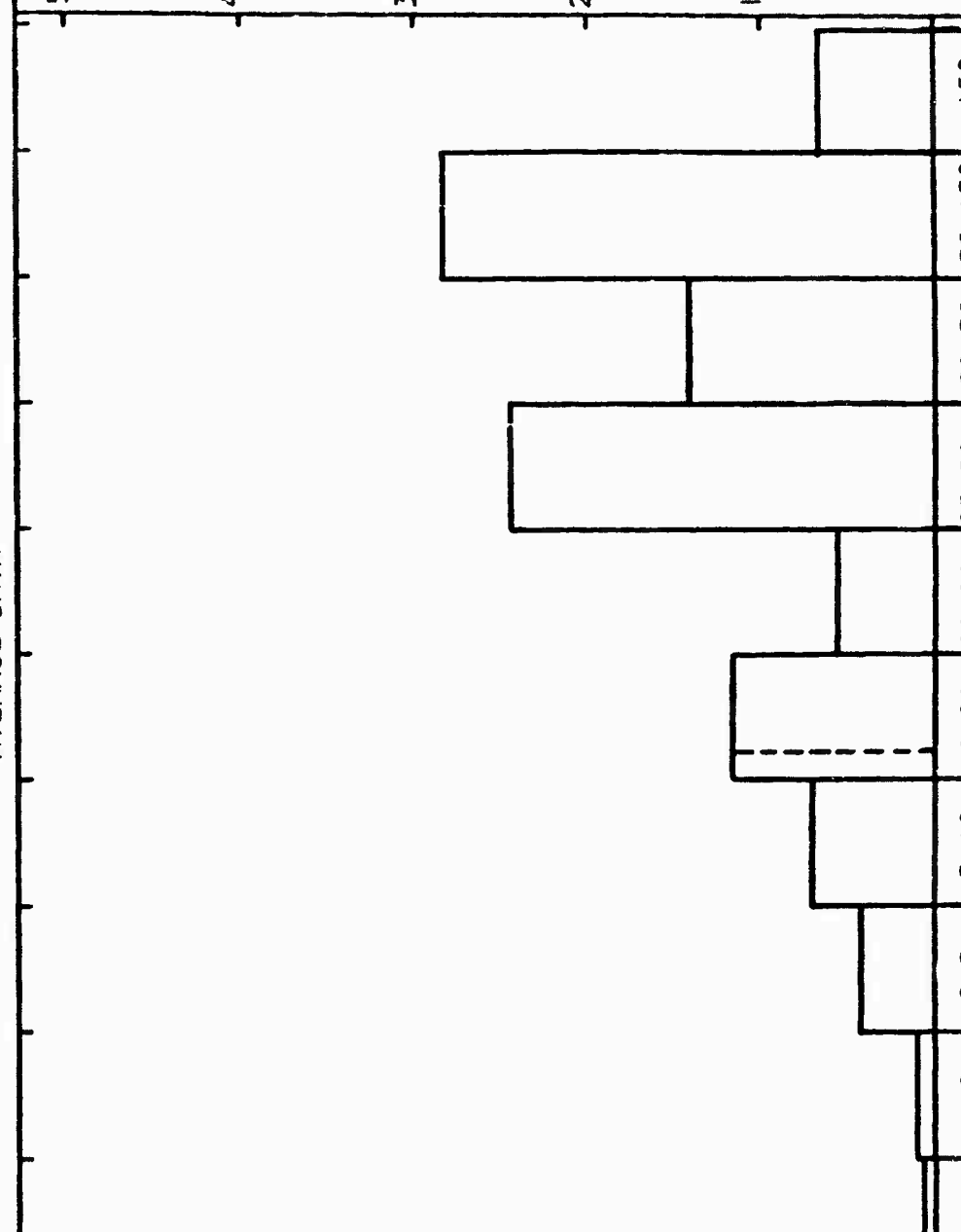
9261

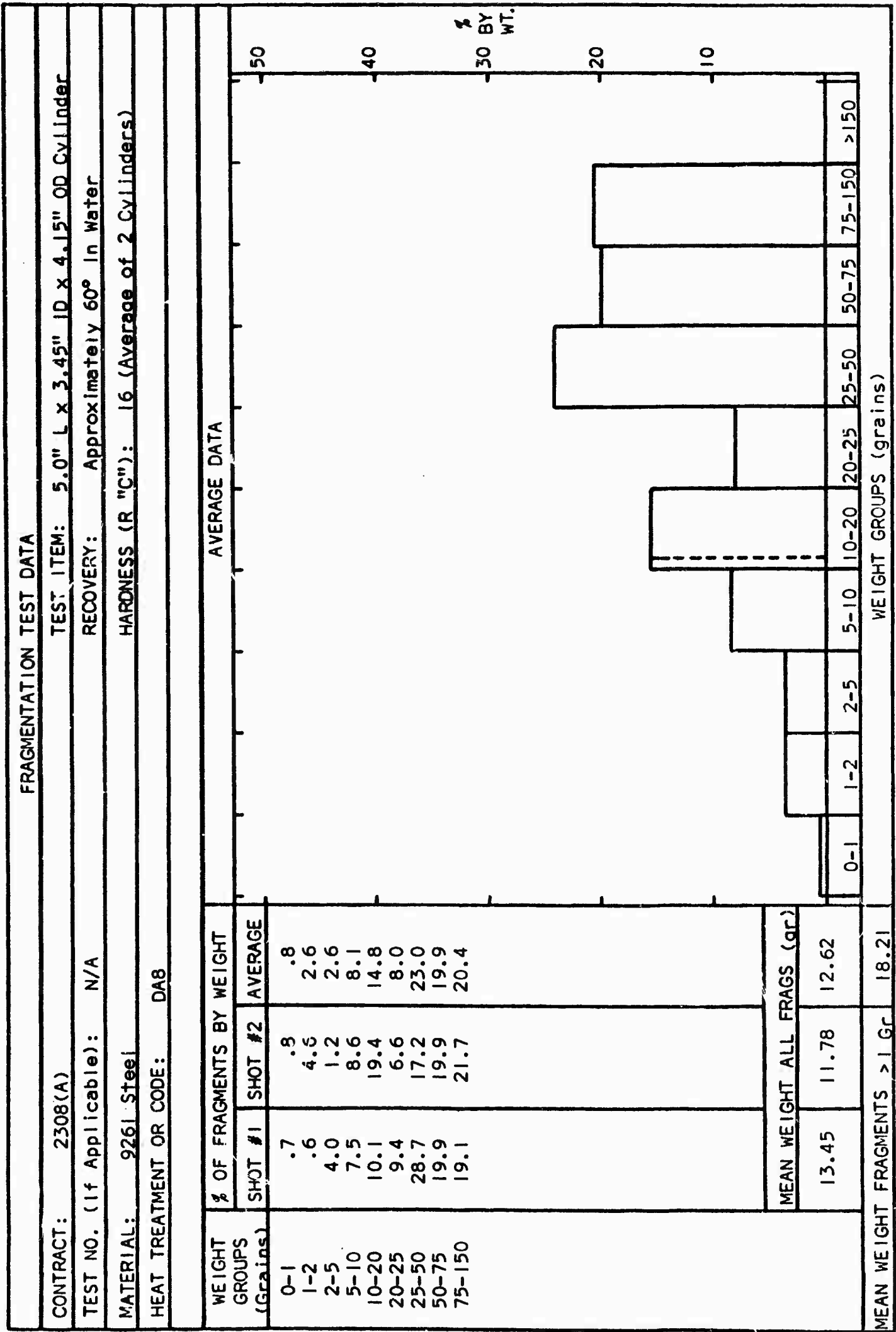
STEEL

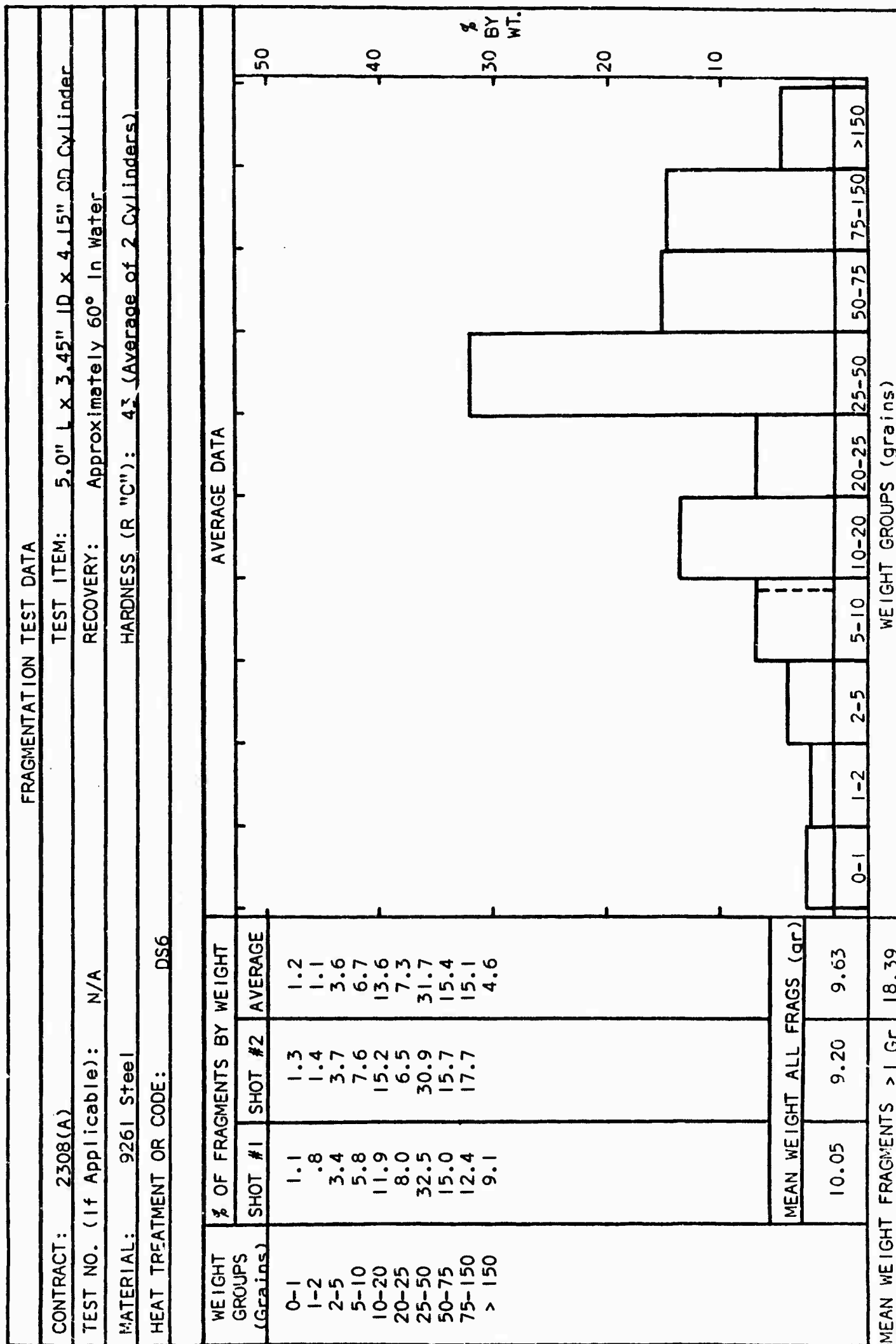
FRAGMENTATION TEST DATA			
CONTRACT: 2308(A)		TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder	
TEST NO. (If Applicable): N/A		RECOVERY: Approximately 60° In Water	
MATERIAL: 9261 Steel		HARDNESS (R "C"): 58 (Average of 2 Cylinders)	
HEAT TREATMENT OR CODE: D06			

% OF FRAGMENTS BY WEIGHT			AVERAGE DATA																
WEIGHT GROUPS (Grains)	SHOT #1	SHOT #2	AVERAGE																
0-1	1.8	1.8	1.8																
1-2	1.9	2.3	2.1																
2-5	7.6	6.9	7.3																
5-10	15.1	12.8	14.0																
10-20	23.5	16.5	20.0																
20-25	7.2	12.3	9.8																
25-50	20.7	32.9	26.8																
50-75	12.1	7.7	9.9																
75-150	11.1	6.8	9.0																
				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">MEAN WEIGHT ALL FRAGS (gr)</th> </tr> </thead> <tbody> <tr> <td style="width: 50%; text-align: center;">7.57</td> <td style="width: 50%; text-align: center;">6.47</td> </tr> <tr> <td colspan="2" style="text-align: center;">7.02</td> </tr> </tbody> </table>										MEAN WEIGHT ALL FRAGS (gr)		7.57	6.47	7.02	
MEAN WEIGHT ALL FRAGS (gr)																			
7.57	6.47																		
7.02																			
MEAN WEIGHT FRAGMENTS > 1 GR				11.67															

FRAGMENTATION TEST DATA				
CONTRACT:		2308(A)		
TEST NO. (If Applicable):		N/A		
MATERIAL:		9261 Steel		
HEAT TREATMENT OR CODE:		D08		
TEST ITEM:		5.0" L x 3.45" ID x 4.15" OD Cylinder		
RECOVERY:		Approximately 60° in Water		
HARDNESS (R "C"):		51 (Average of 2 Cylinders)		
AVERAGE DATA				
WEIGHT GROUPS (Grains)	% OF FRAGMENTS BY WEIGHT			
	SHOT #1	SHOT #2	AVERAGE	
0-1	.5	.6	.6	
1-2	.4	.8	.6	
2-5	2.0	3.1	2.6	
5-10	3.2	5.3	4.3	
10-20	3.8	11.3	7.6	
20-25	.9	3.4	2.2	
25-50	11.3	22.8	17.1	
50-75	14.8	7.0	10.9	
75-150	56.3	18.6	37.5	
> 150	6.8	27.1	17.0	
MEAN WEIGHT ALL FRAGS (gr)				
22.06			14.18	18.12
MEAN WEIGHT FRAGMENTS > 1 Gr			29.87	

FRAGMENTATION TEST DATA				
CONTRACT:	2308(A)	TEST ITEM:	5.0" L x 3.45" ID x 4.15" OD Cylinder	
TEST NO. (If Applicable):	N/A	RECOVERY:	Approximately 60° In Water	
MATERIAL:	9261 Steel	HARDNESS (R "C"):	15 (Average of 2 Cylinders)	
HEAT TREATMENT OR CODE:		DA6		
AVERAGE DATA				
WEIGHT GROUPS (Grains)	% OF FRAGMENTS BY WEIGHT			
	SHOT #1	SHOT #2	AVERAGE	
0-1	.7	1.0	.9	
1-2	.4	1.5	1.0	
2-5	3.2	5.2	4.1	
5-10	6.2	8.4	7.3	
10-20	7.8	13.6	10.7	
20-25	5.1	5.7	5.4	
25-50	20.5	26.5	23.5	
50-75	18.8	8.3	13.6	
75-150	24.1	29.8	27.0	
> 150	13.2		6.6	
MEAN WEIGHT ALL FRAGS (gr)				
	15.80	10.60	13.20	
MEAN WEIGHT FRAGMENTS > 1 Gr			19.38	





FRAGMENTATION TEST DATA		
CONTRACT:	2308(A)	TEST ITEM: 5.0" L x 3.45" ID x 4.15" OD Cylinder
TEST NO. (If Applicable):	N/A	RECOVERY: Approximately 60° In Water
MATERIAL:	9261 Steel	HARDNESS (R "C"): 40 (Average of 2 Cylinders)
HEAT TREATMENT OR CODE:	DF06	

